MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

PEM0016 – ALGEBRA

(Foundation in Engineering)

18 OCTOBER 2019
3:00 p.m. – 5:00 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **THREE (3) pages** including cover page with **FOUR (4) questions** only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided. All necessary working **MUST** be shown.
4. Only **non-programmable** calculator is allowed.

QUESTION 1 [25 marks]

a. Find all real solutions:

i. $x^2(x-1)+(x-1)=0$ (3 marks)

ii. $\sqrt{2x+4}-\sqrt{3x+1}=1$ (8 marks)

b. Solve the given equation in the complex number system:

$$x^2(x^2+17)+16=0$$ (5 marks)

c. Solve the inequality and graph the solution set.

$$2-\left|3x-\frac{x}{3}\right|>-4$$ (4 marks)

d. Solve the inequality and express your answer using interval notation. (5 marks)

$$\frac{(16-x^2)(2-x)}{(x+1)^2}\le 0.$$

QUESTION 2 [25 marks]

a. A function $f(x)$ is defined as

$$f(x)=\begin{cases} 1-x & , \quad -3\le x<0 \\ x^2 & , \quad x\ge 0 \end{cases}$$

i. Evaluate $f(-3)$, $f(0)$, and $f(3)$. (2 marks)

ii. Sketch the graph of $f(x)$. State the domain and range. (4 marks)

b. i. Sketch the graph of $f(x)=3+\ln(x+1)$ by using transformation techniques. Show complete transformation from the graph of $y=\ln x$. (3 marks)

ii. Identify the vertical asymptote, domain and range of $f(x)$. (3 marks)

c. Given $f(x)=2x-3$ and $g(x)=\frac{3}{x-1}$, find

i. $f^{-1}(x)$. (2 marks)

ii. $(f\circ g)(x)$. (2 marks)

iii. $(g\circ g)(x)$. (3 marks)

iv. the domain of $f\circ g$ and $g\circ g$. (2 marks)

d. Solve: $\frac{2}{4^{x+2}}=32$. (4 marks)

Continued.....

QUESTION 3 [25 marks]

a. Given that $(x+4)$ is a factor of $f(x)=2x^3+3x^2+ax-12$. When $f(x)$ is divided by $(x-1)$, the remainder is b.

i. Find the value of a and b. (4 marks)

ii. Find all the solutions of $f(x)=0$. [*Hint*: Use synthetic division.] (5 marks)

iii. Sketch the polynomial function and clearly locate the x and y-intercept on the graph. (5 marks)

b. The seventh term in the expansion of $(a+bx)^{12}$ in ascending power of x is $924x^6$. It is known that, a and b are positive constants.

i. Show that $\frac{1}{a}=b$. (3 marks)

ii. Hence, find the value of a and b if the sixth term in the expansion of $(a+bx)^{12}$ in ascending power of x is $198x^5$. (4 marks)

c. Find the partial decomposition of $\frac{x+7}{x^2-x-6}$. (4 marks)

QUESTION 4 [25 marks]

a. Let:

$$A=\begin{bmatrix}1 & -2 & 4\\ 3 & 0 & 1\end{bmatrix},\quad B=\begin{bmatrix}1 & -1 & 2\\ 3 & 1 & -1\\ 2 & 1 & 0\end{bmatrix} \text{ and } C=\begin{bmatrix}2 & -2\\ 1 & 1\\ 3 & 4\end{bmatrix}$$

Find

i. $(A+C^T)B$ (5 marks)

ii. C^TB-AB^T (6 marks)

b. Apply the Cramer's Rule to solve the following system of equations.

$$x+y-z=4$$
$$x-y+z=2$$
$$2x-y-z=-3$$

(14 marks)

End of Page

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STUDENT ID NO

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FINAL EXAMINATION

TRIMESTER 1, 2019/2020

PCM0035 – GENERAL CHEMISTRY

(Foundation in Engineering)

16 OCTOBER 2019
9.00 a.m – 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of 4 pages excluding the cover page with 3 Questions only.

2. Attempt **ALL** questions. Distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

QUESTION 1 [15 MARKS]

(a) Write the full ground-state electron configuration for the following atom or ion:

(i) Sr^{2+} [1 mark]
(ii) Cr [1 mark]
(iii) Se^{2-} [1 mark]
[Atomic number: Sr = 38; Cr = 24; Se = 34]

(b) How many electrons in an atom can have the following quantum number or sublevel designations?

(i) $n = 4, l = 2, m_l = +1$ [½ mark]
(ii) $4p$ [½ mark]
(iii) $n = 5, l = 3$ [½ mark]

(c) Arrange the following atom or ion in the order of increasing size. Explain your answer.

(i) Fe, Fe^{2+}, Fe^{3+} [1½ marks]
(ii) S, S^{2-}, O [1½ marks]
[Atomic number: Fe = 26; S = 16; O = 8]

(d) Given a compound of N_2O.

(i) Draw the Lewis structure for N_2O. [Hint: N is central] [1½ mark]
(ii) State the number of lone pair electrons that it has. [1 mark]
(iii) Does the structure obey the octet rule or not? [1 mark]
[Atomic number: N = 7; O = 8]

(e) Name the shape (molecular geometry) and give the AB_mE_n classification for CO_3^{2-}.
[Atomic number: C = 6; O = 8] [2 marks]

(f) For the following compound in **Figure 1**:

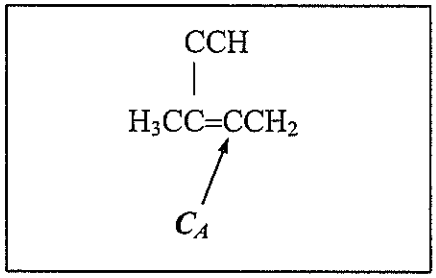

Figure 1

Continued...

(i) Predict the correct hybridization for the carbon atom, C_A, indicated in the molecule shown in Figure 1.

[1 mark]

(ii) Determine the number of sigma (σ) bonds and pi (π) bonds in the molecule.

[1 mark]

QUESTION 2 [15 MARKS]

(a) The phase diagram of a substance Z is given in **Figure 2**. Consider a sample of Z at point A.

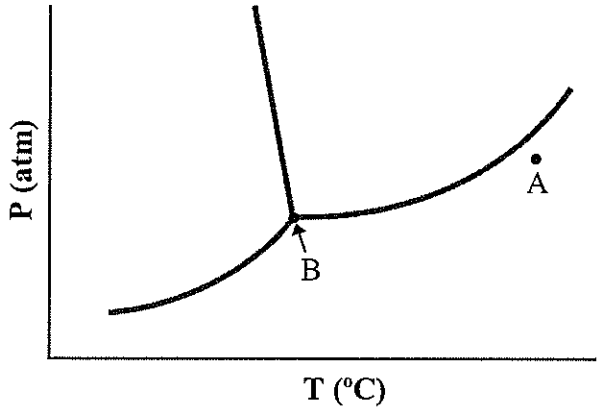

Figure 2

(i) Provide the name for point B and describe the condition of substance Z at this point.

[2 marks]

(ii) Explain what would happen when substance Z at point A is cooled at constant pressure.

[2 marks]

(b) Diamond and graphite are chemically identical, both composed of the element carbon. Explain why diamond is harder than graphite.

[2 marks]

(c) Pressure cooker is a sealed vessel that allows steam to escape when it exceeds a predetermined pressure. The use of pressure cooker can reduce the time needed for cooking. Why?

[1½ marks]

(d) Write the rate expression for the following reactions in terms of the appearance of the products and disappearance of the reactant.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

[1½ marks]

Continued...

(e) The following data was obtained from the reaction A + B → C + D at 28°C.

Experiment	[A] (mol/L)	[B] (mol/L)	Initial rate of reaction (mol/L·s)
1	0.5	0.5	2
2	2.0	0.5	4
3	2.0	1.0	8
4	0.125	2	?

(i) What is the order of reaction with respect to A? [1½ marks]
(ii) What is the order of reaction with respect to B? [1½ marks]
(iii) What is the overall order of the reaction? [½ mark]
(iv) Find the rate constant at 28°C. [1½ marks]
(v) Predict the initial rate of reaction in experiment 4. [1 mark]

QUESTION 3 [20 MARKS]

(a) (i) Give two properties of acids. [2 marks]
(ii) Complete and balance the equation for the neutralization reaction between aqueous HCl and aqueous $Ca(OH)_2$ below:

$$HCl\ (aq) \quad + \quad Ca(OH)_2\ (aq) \quad \rightarrow$$

[2 marks]

(b) Calculate the pH and $[H^+]$ concentration of 0.1 *M* $Al(OH)_3$ [3 marks]

(c) Based on their electronegativity and/or molecular structure, pick which acid is stronger.
(i) HBr or HI [1 mark]
(ii) $HClO_2$ or $HClO_4$ [1 mark]

(d) Determine the oxidation state (oxidation number) for the atom in the following compounds:
(i) Atom S in SO_4^{2-} [1 mark]
(ii) Atom O in Na_2O_2 [1 mark]

(e) Calcium is obtained industrially by electrolysis of molten $CaCl_2$ and used in aluminum alloys.
[Atomic mass Ca = 40.08; Faraday constant = 96 500 C/mol·e^-]
(i) Calculate the amount of charge (in coulomb) needed to produce 10.0 g of Ca metal.
[2 marks]
(ii) If the cell runs at 15.0 A, determine the amount of time it takes to produce 10.0 g of Ca(*s*).
[1 mark]

Continued...

(f) Consider the following voltaic cell in **Figure 3**:

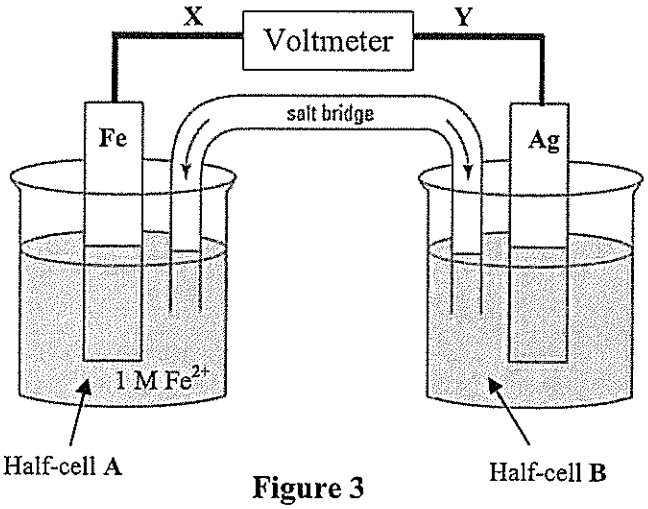

Figure 3

(i) In which direction (**X** to **Y**, or **Y** to **X**) do electrons flow through the external circuit? [1 mark]

(ii) In which half-cell (**A** or **B**) does oxidation occur? [1 mark]

(iii) In which half-cell (**A** or **B**) do electrons enter the cell? [1 mark]

(iv) Which electrode is negatively charge? [1 mark]

(v) Write the balanced equations for the reactions that take place at the anode. [1 mark]

(vi) Write the balanced overall cell reaction equation. [1 mark]

End of Paper